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**Raytheon**

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# R29600 Series Standard PROMs and Power- Switched SPROMs

## Features/Benefits

- All devices are available in both commercial (0°C to +75°C) and military (-55°C to +125°C) temperature range
- All standard PROMs are offered in power-switched SPROM versions
- Radiation tolerant
- Typically, 75% power savings achieved on deselected SPROMs
- Device pinouts comply with JEDEC standards
- All devices programmed on standard PROM programmers
- Reliable nichrome fuses
- Three-state outputs
- Available in surface mount and through-hole packaging

## Applications

- Microprogram control store
- Microprocessor program store
- Programmable logic
- Custom look-up tables
- Security encoding/decoding
- Code converter
- Character generator
- Use in redundant systems

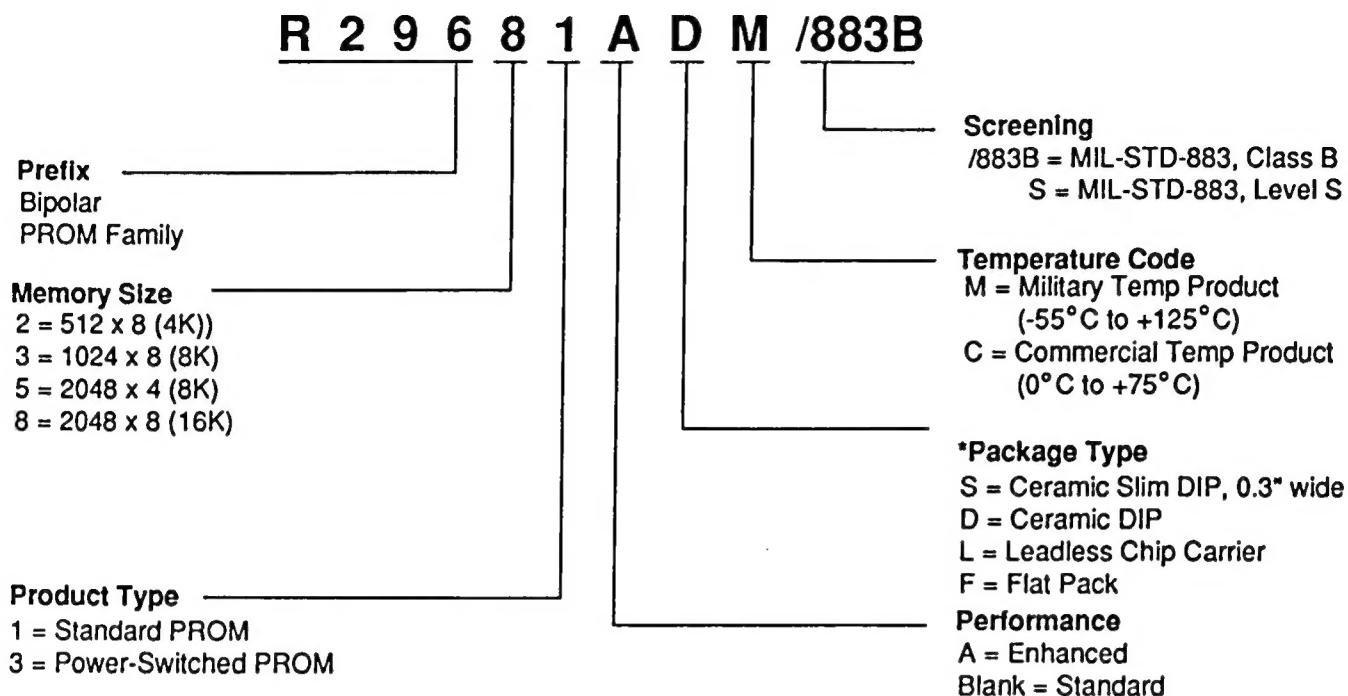
## Description

Raytheon's R29600 Series of Bipolar Field Programmable Read-Only Memories include both standard and power-switched versions. Chip select inputs provide logic flexibility and ease of memory expansion decoding.

All Raytheon R29600 Series PROMs and SPROMs are manufactured with nichrome fuses and low power Schottky technology. The devices are shipped with all bits in the HIGH (logical ONE) state. To achieve a LOW state in a given bit location the nichrome link is fused open by passing a short, high current pulse through the link. All R29600 Series devices are programmed using the same programming technique.

Standard PROMs are enabled when  $\overline{CS}$  is low and CS is high. Power-switched SPROMs are enabled when PS is low and PS is high. See individual data sheets for device enabling schemes.

## Standard Product Ordering Information



## Country of Origin Designator - Prefixes Date Code

O = U.S.A

65-4058

## JAN Ordering Information

## MIL-M-38510 Slash Sheet Part Number

Mil-M-38510/20902BVA

Mil-M-38510/20904BJA

Mil-M-38510/21002BJA

## Raytheon Part Number

JR29651DQ (2K x 4, 18-pin ceramic DIP)

JR29631DR (1K x 8, 24-pin ceramic DIP)

JR29681DR (2K x 8, 24-pin ceramic DIP)

Raytheon Semiconductor CAGE Code Number — 07933

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**Absolute Maximum Ratings** (above which the useful life may be impaired)

Supply Voltage to Ground Potential (continuous), $V_{CC}$	-0.5V to +7.0V
DC Input Current	-30 mA to +5.0 mA
DC Input Voltage (address inputs)	-0.5V to +5.5V
DC Input Voltage (chip/power select input pin)	-0.5V to +33V
DC Voltage Applied to Outputs (except during programming)	-0.5V to $V_{CC}$ max.
Output Current into Outputs During Programming	240 mA
DC Voltage Applied to Outputs During Programming	26V
Junction Temperature	+175°C
Storage Temperature	-65°C to +150°C
Programming Temperature	25 ±5°C
Current Density (metallization)	< 5 × 10 <sup>5</sup> A/cm <sup>2</sup>
Lead Temperature (soldering, 10 seconds)	300°C
Thermal Resistance, Junction-to-Case $\theta_{JC}$	
Dual-In-Line	≤ 11°C/W
Leadless Chip Carrier	≤ 10°C/W

**Operating Conditions**

Parameter	Description	Commercial		Military		Unit
		Min.	Max.	Min.	Max.	
$V_{CC}$	Supply Voltage	4.75	5.25	4.5	5.5	V
$T_C$	Case Operating Temperature			-55	+125	°C
$T_A$	Ambient Operating Temperature	0	+75			°C
$V_{IL}^*$	DC/Functional Low Level Input Voltage		0.8		0.8	V
$V_{IH}^*$	DC/Functional High Level Input Voltage	2.0		2.0		V
$V_{IL}$	AC Low Level Input Voltage		0		0	V
$V_{IH}$	AC High Level Input Voltage	3.0		3.0		V

\*Functional tests shall be conducted at input test conditions as follows:  $V_{IH} = V_{IH}(\text{min}) + 20\%$ ,  $-0\%$ ;  $V_{IL} = V_{IL}(\text{max}) + 0\%$ ,  $-50\%$ . Devices may be tested using any input voltage within this input voltage range but shall be guaranteed to  $V_{IH}(\text{min})$  and  $V_{IL}(\text{max})$ . CAUTION: To avoid test correlation problems, the test system noise (e.g., testers, handlers, etc.) should be verified to assure that  $V_{IH}(\text{min})$  and  $V_{IL}(\text{max})$  requirements are not violated at the device terminals.

## Electrical Characteristics

### Over Operating Range

Military devices conform to Mil-Std-883, Group A, Subgroups 1, 2 and 3

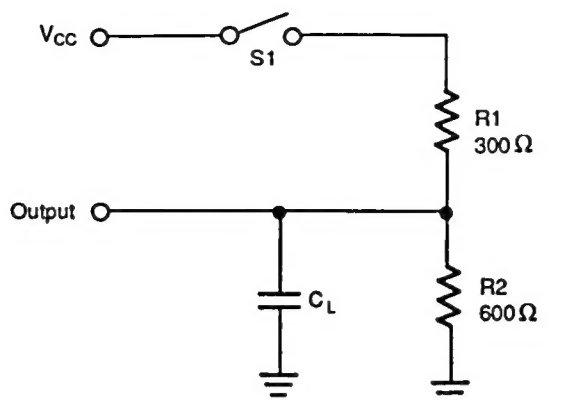
Parameter	Description	Test Conditions	Min	Max	Units
$V_{OH}$	Output High Voltage	$V_{CC} = \text{Min}, I_{OH} = -2 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	2.4		V
$V_{OL}^{(1)}$	Output Low Voltage	$V_{CC} = \text{Min}$ $I_{OL} = 8 \text{ mA}$		0.4	V
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OL} = 16 \text{ mA}$		0.5	
$I_{IL}$	Input Low Current	$V_{CC} = \text{Max}, V_{IN} = 0.4 \text{ V}$		-250	$\mu\text{A}$
$I_{IH}$	Input High Current	$V_{CC} = \text{Max}, V_{IN} = 2.7 \text{ V}$		10	$\mu\text{A}$
		$V_{CC} = \text{Max}, V_{IN} = 5.5 \text{ V}$		40	
$I_{OS}^{(2)(3)}$	Output Short Circuit Current	$V_{CC} = \text{Max}, V_{OUT} = 0.0 \text{ V}$	-15	-85	mA
$V_{IC}$	Input Clamp Voltage	$V_{CC} = \text{Min}, I_{IN} = -18 \text{ mA}$	-1.2	V	
$I_{CEX}$	Output Leakage Current	$V_{CC} = \text{Max}$ $V_{OUT} = 5.5 \text{ V}$		+40	$\mu\text{A}$
		Chip Disabled $V_{OUT} = 0.4 \text{ V}$		-40	

### Notes

1. This characteristic cannot be tested prior to programming; it is guaranteed by factory testing.
2. Not more than one output should be shorted at a time. Duration of the short circuit should not exceed 1 second.
3.  $V_{OUT} = 0.2 \text{ V}$  for military temperature range product.

### Pin Names

Symbol	Description
$A^0 - A^N$	Address Inputs
$\overline{CS}$	Chip Select Active Low (PROM)
CS	Chip Select Active High (PROM)
$\overline{PS}$	Power Select Active Low (SPROM)
PS	Power Select Active High (SPROM)
$O^I - O^N$	Data Outputs

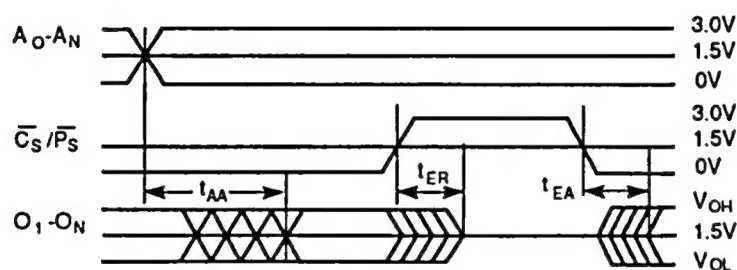


65-4059

## Notes:

1.  $t_{AA}$  is tested with switch  $S_1$  closed and  $C_L = 30$  pF.
2.  $t_{EA}$  is tested with  $C_L = 30$  pF;  $S_1$  is open for high impedance to "1" test and closed for high impedance to "0" test.
3.  $t_{ER}$  is tested with  $C_L = 5$  pF;  $S_1$  is open for "1" to high impedance test and measured at  $V_{OH} - 0.5V$  output level and is closed for "0" to high impedance test and measured at  $V_{OL} + 0.5V$  output level.

Figure 1. AC Test Load Circuit



## Keys to Timing Diagram

Waveforms	Inputs	Outputs
—	Must be Steady	Will be Steady
XXX	Don't Care. Any Change Permitted	Changing State Unknown
≡	Does Not Apply	Center Line is High Impedance Off State

65-4060

Figure 2. Switching Waveforms



**512 x 8 SPROM — R29623/R29623A****Power and AC Characteristics Over Operating Range**

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

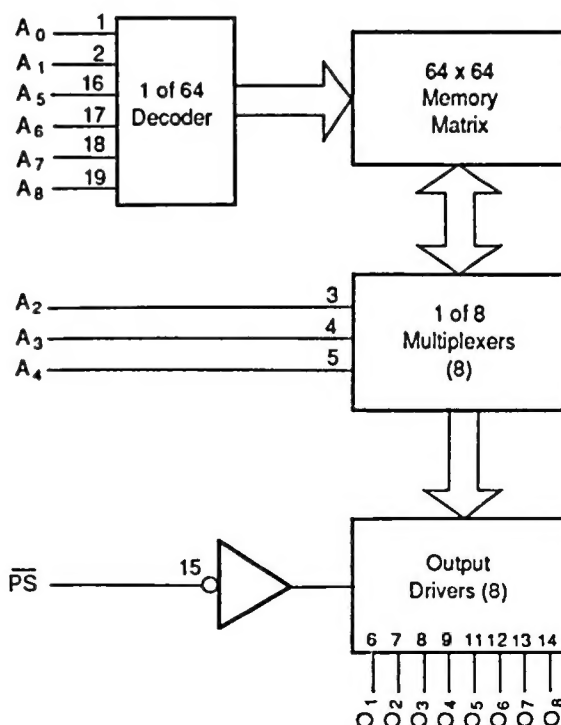
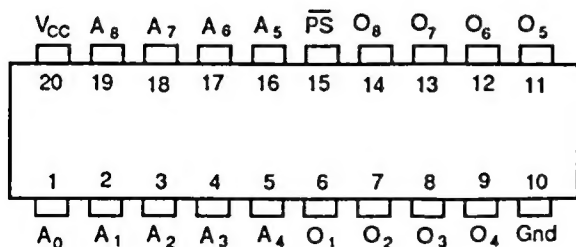
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Parameter	Description	Test Conditions	Maximum Limits				Units
			R29623AC	R29623C	R29623AM	R29623M	
$I_{CCD}$	Power Down, Supply Current (disabled)	$V_{CC} = \text{Max}$ $\overline{PS} = V_{IH}$ , All other inputs = GND	45	45	45	45	mA
$I_{CC}$	Supply Current (enabled)	$V_{CC} = \text{Max}$ All inputs = Gnd	155	155	155	155	mA
$t_{AA}$	Address Access Time	$C_L = 30 \text{ pF}^*$ $R_1 = 300\Omega \text{ to } V_{CC}$ $R_2 = 600\Omega \text{ to GND}$ 16 mA Load	50	70	60	85	ns
$t_{EA}$	Enable Access Time		55	70	65	85	ns
$t_{ER}$	Enable Recovery Time		30	30	40	40	ns
$P_D$	Power Dissipation (Disabled)		236	236	248	248	mW
$P_D$	Power Dissipation (Enabled)		814	814	853	853	mW

\*See AC Test Load Circuit and Switching Waveforms

Conforms to MIL-STD-1835

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T20	R, 12, A	D-8

**Block Diagram****Pin Out Information****Dual In-Line Package**

Pin 15 is also the programming pin (pp)

65-1316

65-0113

**1024 x 8 PROM — R29631/R29631A****Power and AC Characteristics Over Operating Range**

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

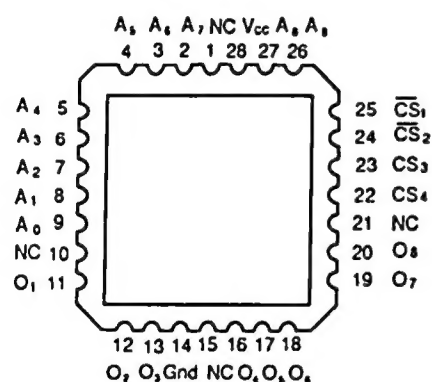
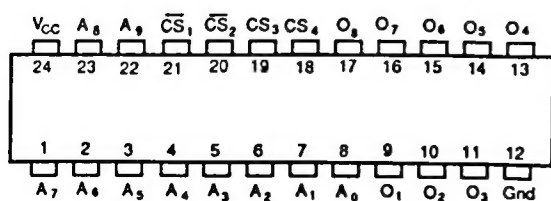
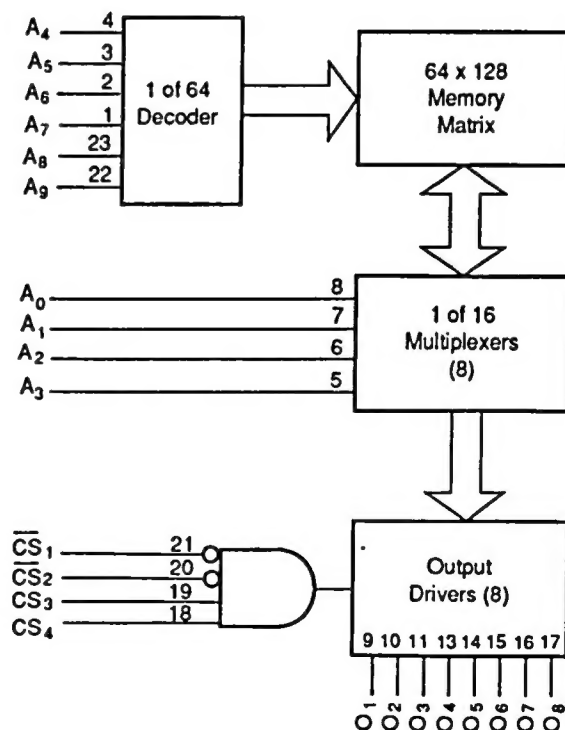
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Parameter	Description	Test Conditions	Maximum Limits				Units
			R29631AC	R29631C	R29631AM	R29631M	
$I_{CC}$	Power Supply Current	$V_{CC} = \text{Max}$ All inputs = Gnd	170	170	170	170	mA
$t_{AA}$	Address Access Time	$C_L = 30 \text{ pF}^*$	50	70	60	90	ns
$t_{EA}$	Enable Access Time	$R1 = 300\Omega \text{ to } V_{CC}$	30	35	40	40	ns
$t_{ER}$	Enable Recovery Time	$R2 = 600\Omega \text{ to GND}$	30	30	40	40	ns
$P_D$	Power Dissipation	16 mA Load	893	893	935	935	mW

\*See AC Test Load Circuit and Switching Waveforms

**Conforms to MIL-STD-1835**

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4
F	GDFP1-F24	11, A	F-16

**Pin Out Information****Leadless Chip Carrier (28-Terminal)****Dual-In-Line Package****Block Diagram**

65-0116

65-4069



**1024 x 8 SPROM — R29633/R29633A****Power and AC Characteristics Over Operating Range**

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

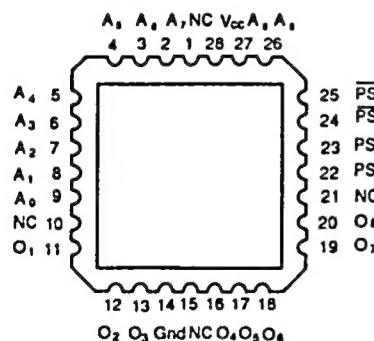
Parameter	Description	Test Conditions	Maximum Limits				Units
			R29633AC	R29633C	R29633AM	R29633M	
$I_{CCD}$	Power Down, Supply Current (Disabled)	$V_{CC} = \text{Max}$ $PS = V_{IH}$ , All other	45	45	45	45	mA
ICC	Supply Current (Enabled)	Inputs = GND $V_{CC} = \text{Max}$ All inputs = GND	170	170	170	170	mA
tAA	Address Access Time	CL = 30 pF*	50	70	70	90	ns
tEA	Enable Access Time	R1 - 300Ω to VCC	50	75	70	115	ns
tER	Enable Recovery Time	R2 - 600Ω to GND	30	30	40	40	ns
PD	Power Dissipation (Disabled)	16 mA Load	236	236	248	248	mW
PD	Power Dissipation Enabled		893	893	935	935	mW

Conforms to MIL-STD-1835

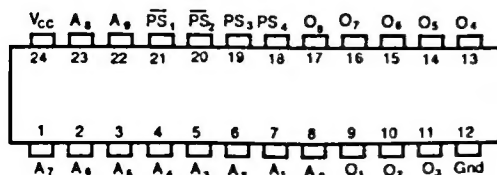
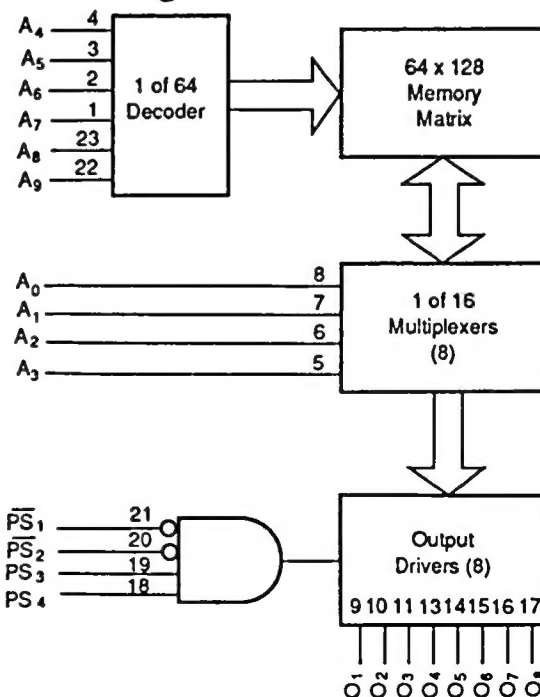
Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4
F	GDFP1-F24	11, A	F-16

**Pin Out Information**

Leadless Chip Carrier (28-Terminal)



Dual In-Line Package

**Block Diagram**

Pin 20 is also the programming pin (pp)

65-4071

65-0117

**2048 x 4 SPROM — R29653/R29653A****Power and AC Characteristics Over Operating Range**

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

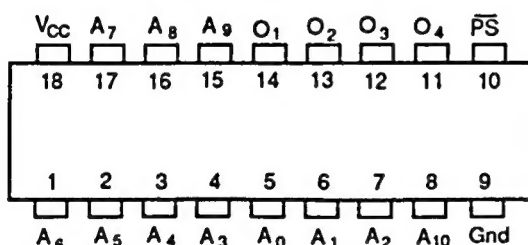
Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Parameter	Description	Test Conditions	Maximum Limits				Units
			R29653AC	R29653C	R29653AM	R29653M	
$I_{CCO}$	Power Down, Supply Current (disabled)	$V_{CC} = \text{Max}$ $PS = V_{IH}$ , All other inputs = GND	45	45	45	45	mA
$I_{CC}$	Supply Current (enabled)	$V_{CC} = \text{Max}$ All inputs = Gnd	170	170	170	170	mA
$t_{AA}$	Address Access Time	$C_L = 30 \text{ pF}^*$	65	75	75	90	ns
$t_{EA}$	Enable Access Time	$R1 = 300\Omega$ to $V_{CC}$	70	80	80	95	ns
$t_{ER}$	Enable Recovery Time	$R2 = 600\Omega$ to GND	35	35	45	45	ns
$P_D$	Power Dissipation (Disabled)	16 mA Load	236	236	248	248	mW
$P_D$	Power Dissipation (Enabled)		893	893	935	935	mW

\*See AC Test Load Circuit and Switching Waveforms

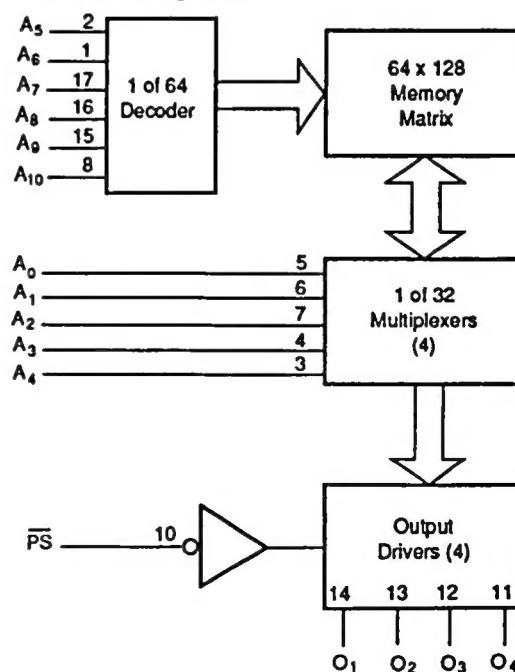
**Conforms to MIL-STD-1835**

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
D	GDIP1-T18	V, 12, A	D-6

**Pin Out Information****Dual In-Line Package**

Pin 10 is also the programming pin (pp)

65-1326

**Block Diagram**

65-0123

**2048 x 8 PROM — R29681/R29681A**

### Power and AC Characteristics Over Operating Range

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

Parameter	Description	Test Conditions	Maximum Limits				Units
			R29681AC	R29681C	R29681AM	R29681M	
I <sub>CC</sub>	Power Supply Current	V <sub>CC</sub> = Max All inputs = Gnd	180	180	180	180	mA
t <sub>AA</sub>	Address Access Time	C <sub>L</sub> = 30 pF *	50	80	70	100	ns
t <sub>EA</sub>	Enable Access Time	R1 = 300Ω to V <sub>CC</sub>	35	40	45	50	ns
t <sub>ER</sub>	Enable Recovery Time	R2 = 600Ω to GND	30	40	35	45	ns
P <sub>D</sub>	Power Dissipation	16 mA Load	945	945	990	990	mW

\*See AC Test Load Circuit and Switching Waveforms

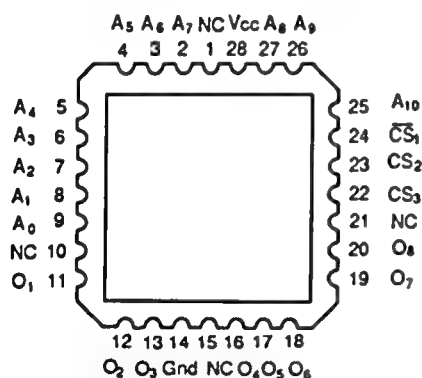
**Conforms to MIL-STD-1835**

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
S	CDIP4-T24	L, 12, C	D-9
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4

**Contact factory for flat pack package.**

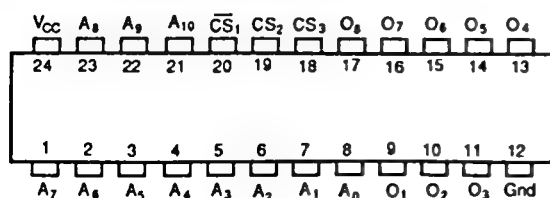
## Pin Out Information

### Leadless Chip Carrier (28-Terminal)



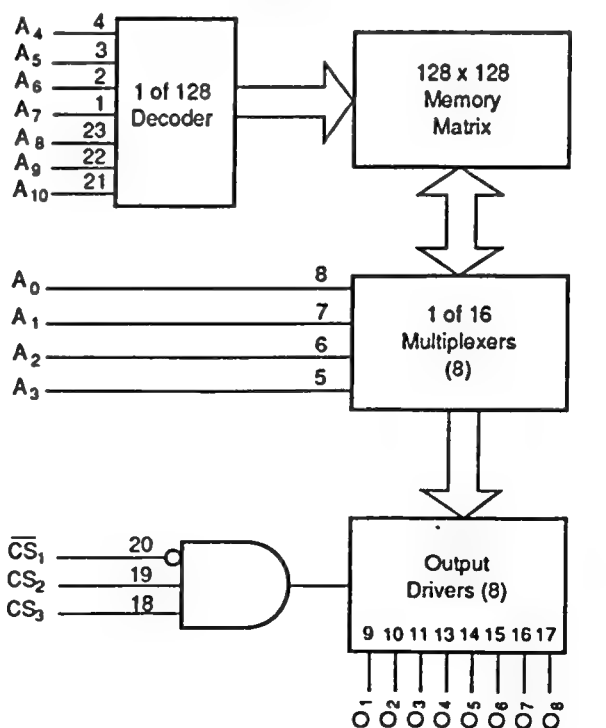
Pin 24 is also the programming pin (pp)

**Dual-In-Line Package**  
**Available in 0.3" and 0.6" Wide Packages**



Pin 20 is also the programming pin (pp)

### Block Diagram



65-0128

**2048 x 8 SPROM — R29683/R29683A****Power and AC Characteristics Over Operating Range**

Military ICC conforms to Mil-Std-883, Group A, Subgroups 1, 2 and 3

Military AC parameters conform to Mil-Std-883, Group A, Subgroups 9, 10 and 11

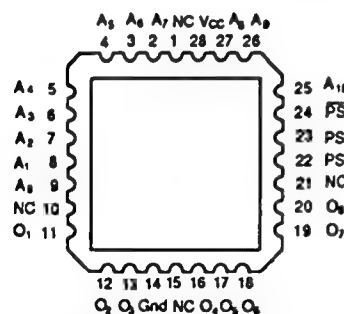
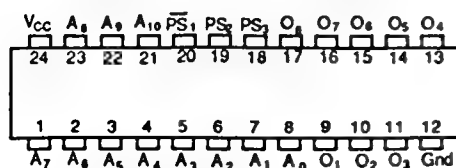
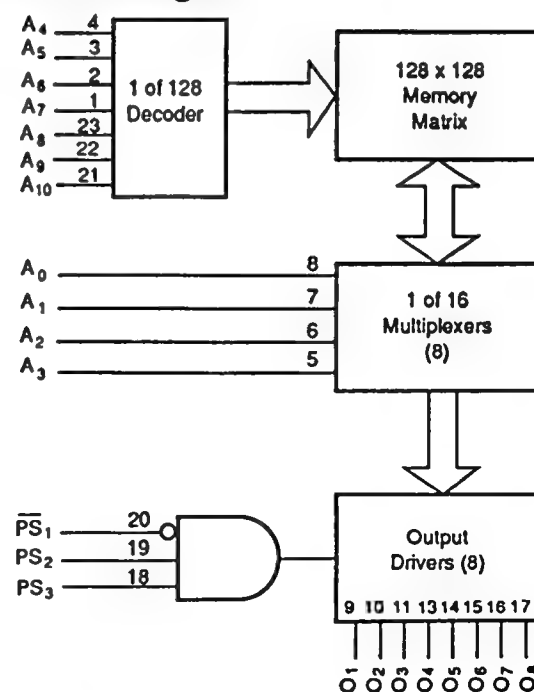
Parameter	Description	Test Conditions	Maximum Limits				Units
			R29683AC	R29683C	R29683AM	R29683M	
$I_{CCD}$	Power Down, Supply Current (disabled)	$V_{CC} = \text{Max}$ $PS = V_{IH}$ , All other inputs = GND	50	50	50	50	mA
$I_{CC}$	Supply Current (enabled)	$V_{CC} = \text{Max}$ All inputs = Gnd	180	180	180	180	mA
$t_{AA}$	Address Access Time	$C_L = 30 \text{ pF}^*$ $R1 = 300\Omega \text{ to } V_{CC}$ $R2 = 600\Omega \text{ to GND}$ 16 mA Load	50	85	70	105	ns
$t_{EA}$	Enable Access Time		65	85	85	105	ns
$t_{ER}$	Enable Recovery Time		35	45	45	50	ns
$P_D$	Power Dissipation (Disabled)		263	263	275	275	mW
$P_D$	Power Dissipation (Enabled)		945	945	990	990	mW

\*See AC Test Load Circuit and Switching Waveforms

**Conforms to MIL-STD-1835**

Raytheon Package Designator	Description Package Type Designator	Case Outline Letter Figure No. Configuration No.	Dimensions Reference Letter
S	CDIP4-T24	L, 12, C	D-9
D	GDIP1-T24	J, 12, A	D-3
L	CQCC1-N28	3, 15	C-4

Contact factory for flat pack package.

**Pin Out Information****Leadless Chip Carrier (28-Terminal)****Dual-In-Line Package**  
Available in 0.3" and 0.6" Wide Packages**Block Diagram**

Pin 20 is also the programming pin (pp)

65-4074

65-0129

## Dynamic Life Test/Burn-In Circuits

In accordance with Mil-Std-883, Methods  
1005/1015, Condition D

$$T_A = 125^{+10}_{-0} \text{ } ^\circ\text{C minimum}$$

$$V_{CC} = 5.25 \pm 0.25\text{V}$$

Square Wave Pulses on  $A^0$  to  $A^n$  are:

50%  $\pm 10\%$  duty cycle

Frequency of each address is to be

1/2 of each preceding input,

with  $A^0$  beginning at 100 kHz

(e.g.,  $A^0 = 100 \text{ kHz} \pm 10\%$ ,

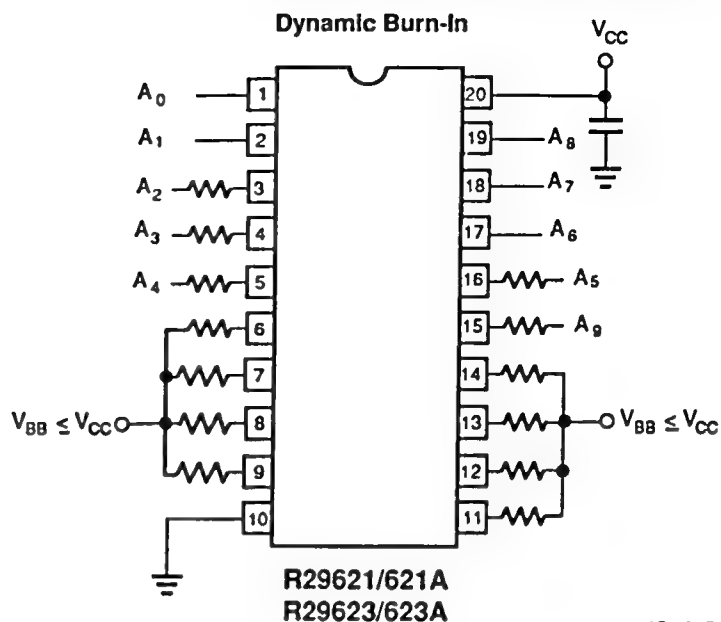
$A^1 = 50 \text{ kHz} \pm 10\%$ ,

$A^2 = 25 \text{ kHz} \pm 10\%$ ,

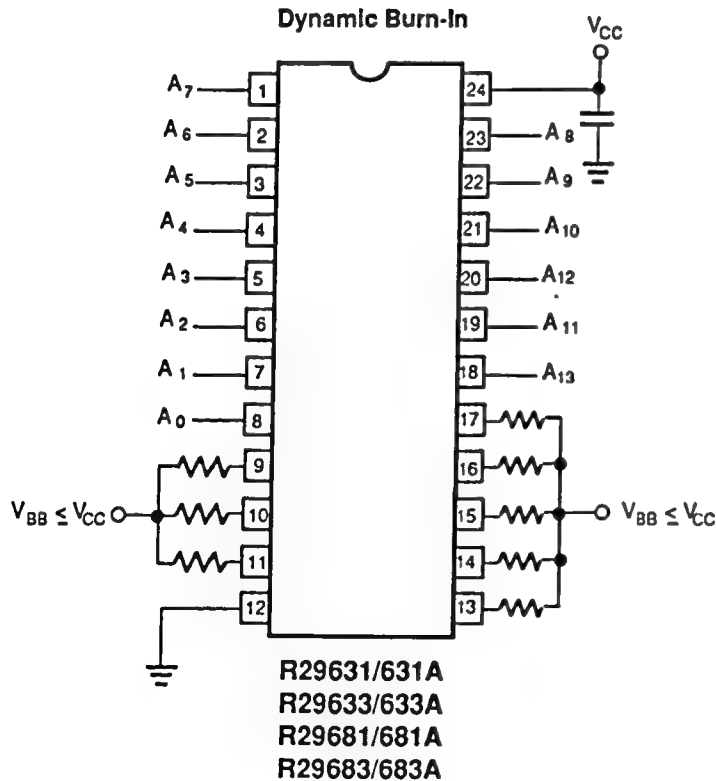
$A^n = 1/2 A^{n-1} \pm 10\%$ , etc.)

Resistors are optional on input pins

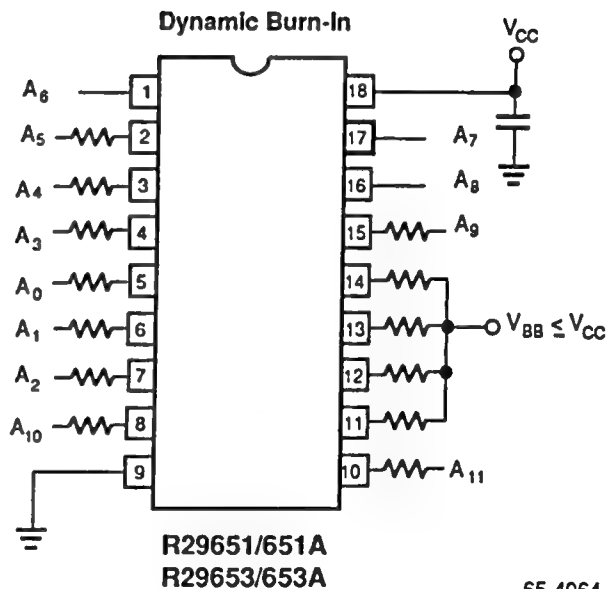
( $R = 300\Omega \pm 10\%$ )



65-4065



65-4063



65-4064

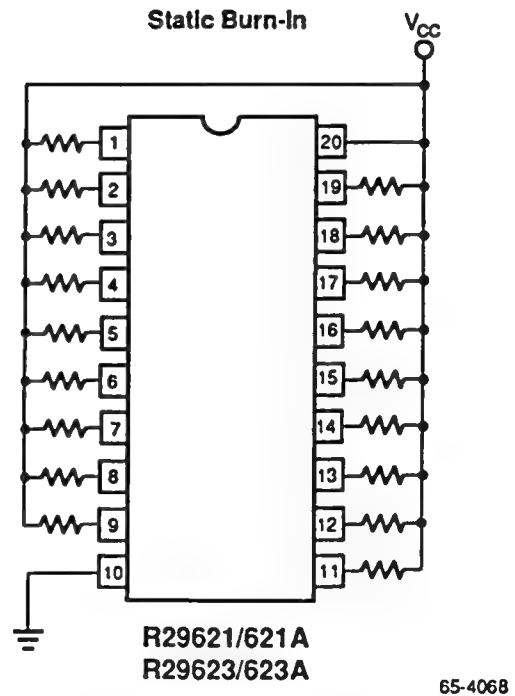
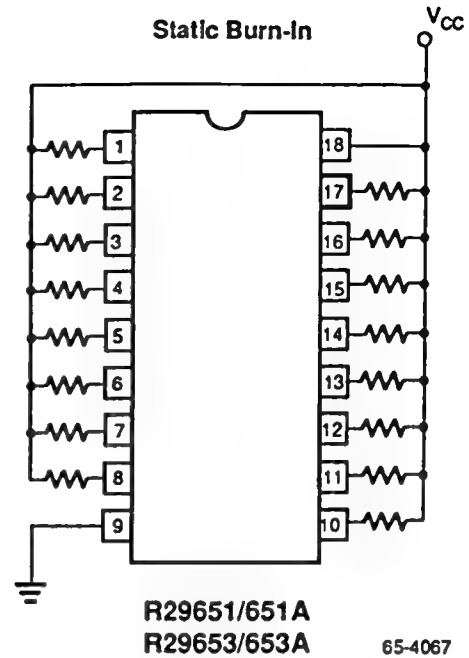
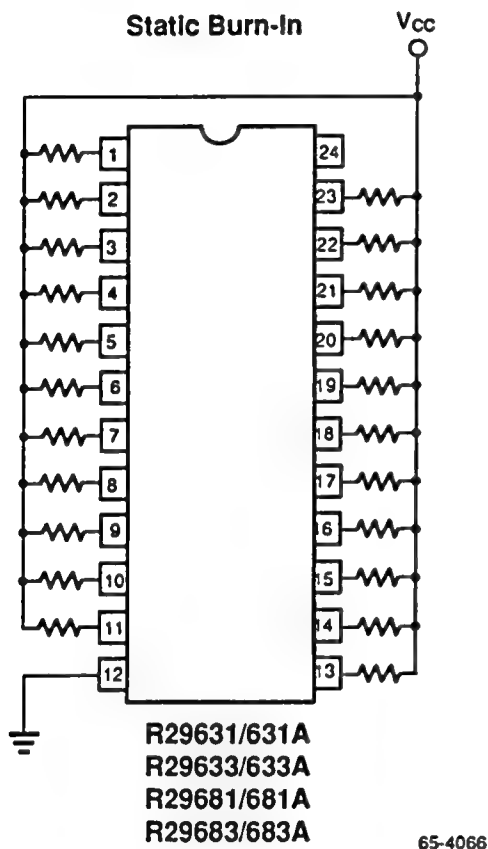
## Static Life Test/Burn-In Circuits

In accordance with Mil-Std-883, Methods 1005/  
1015, Condition C

$$T_A = 125^{+10}_{-0} \text{ } ^\circ\text{C minimum}$$

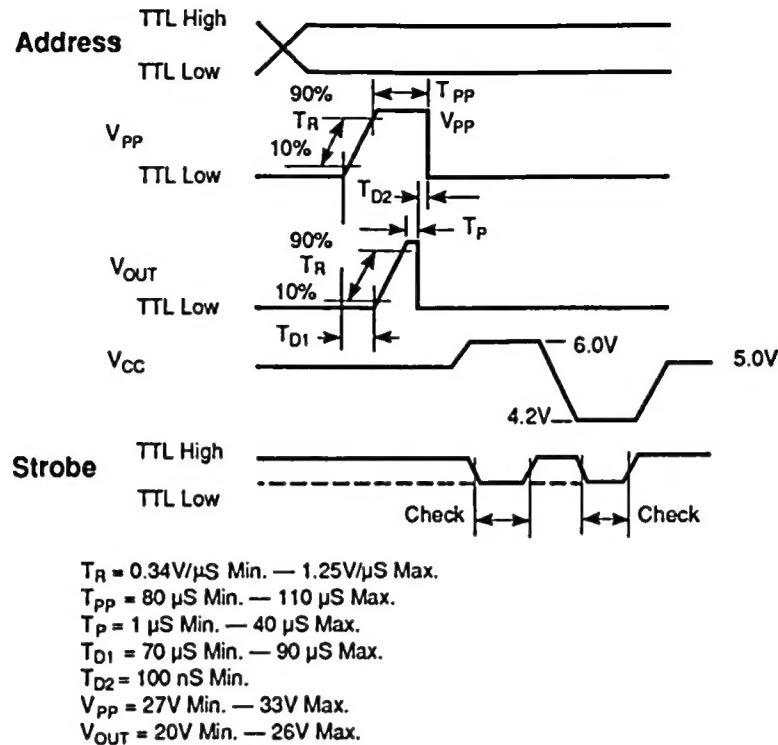
$$V_{CC} = 5.25\text{V} \pm 0.25\text{V}$$

Resistors are optional on input pins  
( $R = 300\Omega \pm 10\%$ )



**Programming Parameters** (Do not test these limits or you may program the device)

Parameter	Description	Test Conditions ( $T_A = 25^\circ\text{C}$ )	Min	Recommended	Max	Units
$V_{CCP}$	$V_{CC}$ required during programming		5.4	5.5	5.6	V
$T_R$	Rise time of program pulse applied to the data out or program pin		0.34	0.4	1.25	V/ $\mu\text{S}$
$T_{PP}$	Programming pulse width		80	95	110	$\mu\text{S}$
$T_P$	Required coincidence among the program pin, output, address and $V_{CC}$ for programming		1.0		40	$\mu\text{S}$
$T_{D1}$	Required time delay between disabling the memory output and application of the output programming pulse	Measure at 10% levels	70	80	90	$\mu\text{S}$
$T_{D2}$	Required time delay between removal of programming pulse and enabling the memory output	Measure at 10% levels	100			ns
$V_{PP}$	Required programming voltage on program pin		27	33	33	V
$V_{OUT}$	Required programming voltage on output pin		20	26	26	V
$I_{OLV1}$	Output current required during verification	Chip enabled $V_{CC} = 4.2\text{V}$	11	12	13	mA
$I_{OLV2}$	Output current required during verification	Chip enabled $V_{CC} = 6\text{V}$	0.1	0.2	0.3	mA
$I_L$	Required current limit of the power supply feeding the program pin and the output during programming	$V_{PP} = 33\text{V}$ $V_{OUT} = 26\text{V}$ $V_{CC} = 5.5\text{V}$	240			mA
MDC	Maximum duty cycle during automatic programming of program pin	$\frac{T_{PP}}{T}$			50	%



Note: Output Load = 0.2 mA During 6.0V Check  
 Output Load = 12 mA During 4.2V Check

65-4075

**Figure 3. Programming Timing**

## Device Programming Inputs

If you would like to have Raytheon program your devices, please submit one of the following:

- Two masters and truth table
- Two masters and checksum

In either case, we require customer approval prior to programming the devices.

Please do not hesitate to contact Raytheon for samples, if you need blank devices to program as masters.



**Commercial Programmers** (subject to change)

Equipment must be calibrated at regular intervals. Each time a new board or a new programming module is inserted, the whole system should be checked. Both timing and voltages must meet published specifications for the device.

Please contact the following manufacturers for equipment information:

Data I/O Corp.  
10525 Willows Road, N.E.  
P.O. Box 97046  
Redmond, WA 98073-9746  
(800) 247-5700

Stag Microsystems Inc.  
1600 Wyatt Drive, Suite 3  
Santa Clara, CA 95054  
(408) 988-1118

**Commercial Surface Mount Socket Adapter Manufacturer** (subject to change)

Please contact the following manufacturer for equipment information:

Emulation Technology, Inc.  
2344 Walsh Avenue, Bldg. F  
Santa Clara, CA 95051  
(408) 982-0660

The companies listed above are not intended to be a complete guide of manufacturers of programmers or adapters, nor does Raytheon endorse any specific company.

## Revisions

Rev. No.	Date	Description
A	12/88	<p>Complete update</p> <p>R29671M: Changed <math>t_{AA}</math> from 100 ns to 95 ns max.</p> <p>R29671AM: Changed <math>t_{AA}</math> from 80 ns to 70 ns max.</p> <p>R29671AC: Changed <math>t_{ER}</math> from 40 ns to 35 ns max.</p> <p>R29631AC: Changed <math>t_{EA}</math> from 35 ns to 30 ns max.</p> <p>R29631C: Changed <math>t_{EA}</math> from 30 ns to 35 ns max.</p> <p><math>I_{IH}</math>: Changed from 0.1 mA to 40 <math>\mu</math>A max.</p> <p><math>V_{IC}</math>: Changed from -1.5V to -1.2V max.</p> <p><math>I_{CEX}</math>: Changed from <math>\pm 100 \mu</math>A to <math>\pm 40 \mu</math>A max.</p> <p>Changed commercial temperature range from 75°C max. to 70°C max.</p> <p><math>I_L</math> (programming parameter): Changed from 250 mA to 240 mA min.</p> <p>Removed R29613/R29613A data sheet.</p>
B	4/92	<p>Removed R29671/R29671A/R29673</p> <p>Removed SMD information</p> <p>Added flat pack information to R29631/R29631A/R29633/R29633A specifications</p> <p>Added resistor value to dynamic and static burn-in circuits</p> <p>Removed programming instructions</p> <p>Changed programming rise time (<math>T_R</math>) from 0.46 V/<math>\mu</math>s max. to 1.25 V/<math>\mu</math>s max.</p> <p>Changed programmer and adapter manufacturer information</p> <p>Changed VO condition for IOS (commercial temperature range) from 0.2V to 0.0V</p> <p>Changed IOS minimum limit from -12 mA to -15 mA</p>

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